WSPRPi: Flashing Bootloader to PIC32

Dan McGraw M0WUT

Abstract

If this following means anything: "Flash WSPRpi_UART_PLUS_TEST.hex from PIC32-Firmware/Bootloader to PIC32MX250F128D using CN9 which is Pickit3 compatible", do that then jump to last instruction.

This document details how to flash the bootloader onto the PIC32 used within WSPRpi. Most PICs require programming using a high voltage external programmer such as a Pickit 3. A bootloader is a simple(ish!) piece of code that (usually) sits at the start of the program and allows the program memory to be written using other means (such as USB) if certain conditions are met on startup when the bootloader code is running, otherwise the program just continues on to the main code.

So far, I have provided 3 bootloaders for the WSPRpi. These can be found in the PIC32-Firmware/Bootloader section of the Github repo. These are:

- WSPRpi_USB.hex

  This is written by the wonderful chipKIT community who produce PIC32 based boards that are compatible with the Arduino IDE to allow them to be easily programmed. Full source is in the README. This allows the PIC32 to be reprogrammed over the Mini USB port (CN3) on the MCU board and is intended for developers. This contains no code other than the bootloader so the bootloader will detect there is no main program loaded and rapidly flash the TX LED but do nothing else.

- WSPRpi_UART.hex

  This is a modified version of the above by M0WUT and allows the PIC32 to be programmed over UART, the communications protocol used between the Pi Zero and the PIC32 on WSPRpi. This will allow the Pi to reprogram the PIC when it detects a firmware update has been released. This contains no code other than the bootloader so the bootloader will detect there is no main program loaded and rapidly flash the TX LED but do nothing else.

- WSPRpi_UART_PLUS_TEST.hex

  This is the same as WSPRpi_UART.hex but also loads a test program to test the basic functionality of the board. This is the one you want if you are building WSPRpi.

These instructions assume that you are building a WSPRpi so will focus on WSPRpi_UART_PLUS_TEST.hex. The procedure for loading the other bootloaders is the same but the WSPRpi won't do anything when the bootloader has been flashed. Note that I don't think it is possible to have a bootloader that can accept both UART and USB program loading so if you program the UART_PLUS_TEST version, you won't be able to develop using the USB port to reprogram the PIC and vice versa, if using USB for development programming, the Pi will fail to perform updates.

To complete these, you will need a external programmer compatible for the PIC32MX250F128D, the standard option would be the Pickit3 which these instructions will cover but other options are available. I will assume if you have another option, you know what you are doing enough to flash a hex file. Anything that can program a PIC32 is fine.

Camb-Hams: I have one that I'm happy to bring to P+P with a laptop set up for this. Email me at least 24h before so I pack my laptop.

- Download MPLABX

  I'm so sorry, this is a MASSIVE download. ~700MB for v4.05 which is the current one as I write this. Downloads tab from MPLABX website: http://www.microchip.com/mplab/mplab-x-ide

- Install it:

  Standard install is fine. When asked what options you want to install, only MPLAB IPE is needed to load the WSPRpi bootloader. All of the options suggested at the "Setup Complete" screen can be ignored as we won't be compiling anything.
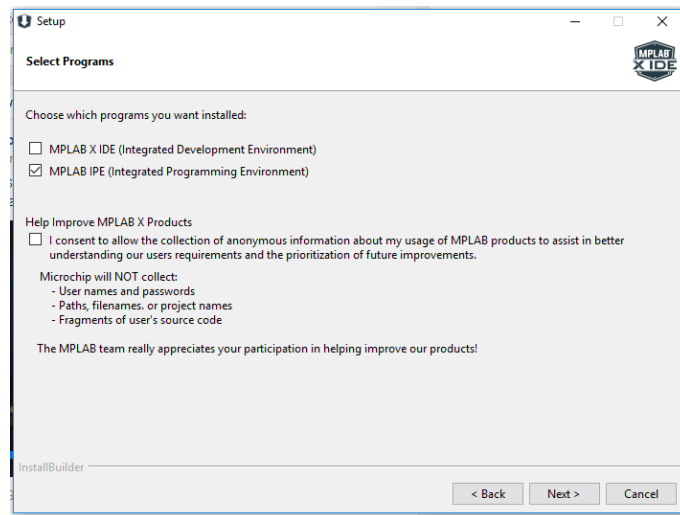
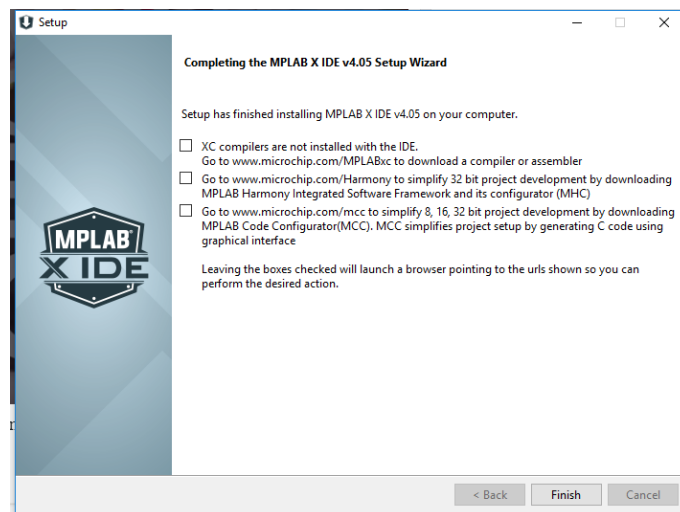Figure 1: Required options for MPLABX install

Figure 2: All notices can be ignored

- Open MPLAB IPE

  In the device box enter "PIC32MX250F128D" and click "Apply"
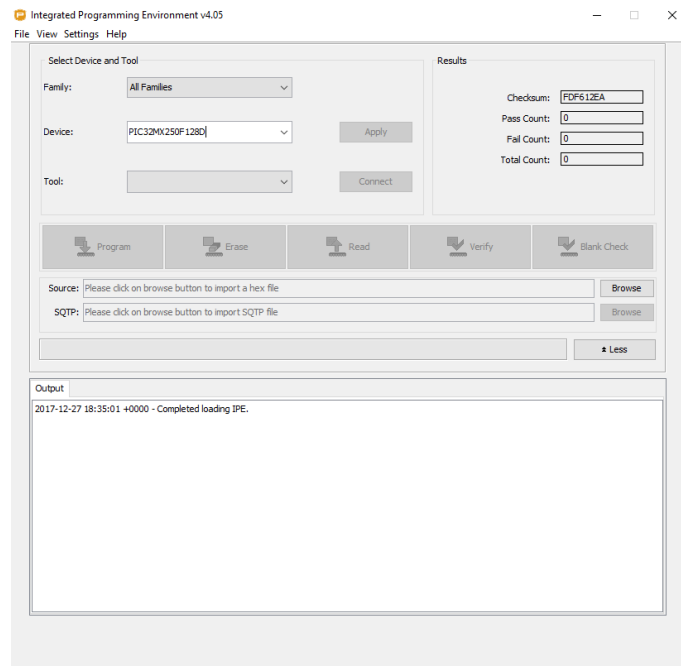
Figure 3: MPLAB IPE

- Connect Pickit3

  Plug the Pickit3 into the WSPRpi at CN9, the white arrow on the Pickit3 should line up with the white arrow on the pin header with a single pin overhanging at the end nearer the Raspberry Pi. The Raspberry Pi will need to be removed for the Pickit3 to be able to be plugged in. Apply power to WSPRpi. Plug the Pickit3 into the computer, a Pickit3 option should appear in the "Tool" menu, then click "Connect"
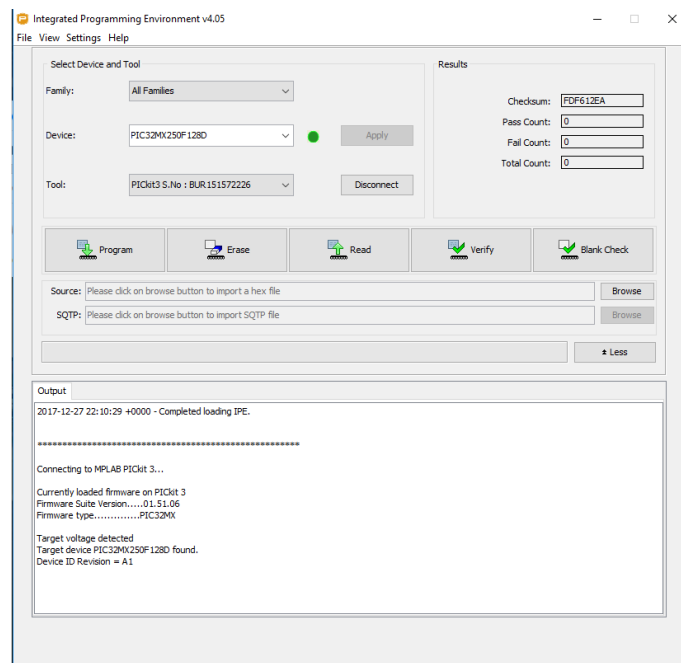

Figure 4: MPLAB IPE connected to WSPRpi

  The important line here is "Target device PIC32MX250F128D found"

- Program the PIC

  Use the "Browse" option to set the source file to the bootloader .hex file of your choice. Again, for standard WSPRpi builds, this is WSPRpi_UART_PLUS_TEST.hex Once done, click "Program" and after a while, the blue text "Programming complete" should appear.

- Test functionality

  Disconnect (using the button in MPIPE) and unplug the Pickit3 from the WSPRpi board. The test feature for each module on the MCU board is as follows, it does not matter if a module is not fitted yet, the other tests will still work:

  - Push buttons and LED

    The LED should turn on while either button is pressed.

  - LCD

    The top line should display "Waiting for GPS" until GPS lock is achieved, then will display time in UTC. The middle line will show if either button is pressed. The bottom line should show a counter, incrementing every second.

  - GPS

    If the GPS achieves lock, the GPS LED (just above the Ethernet socket) will pulse once per second and the LCD will show the time in UTC on the top line.